1905MNRAS..66...41S

$\delta\pi$. Moreover the numerical changes are small compared with the large "observed *minus* theoretical" value of $\delta\pi$, the longitude of the perihelion of *Mercury*. The motion of *Mercury's* perihelion remains anomalous, and is not shown to be the geometrical effect of ignoring secular variations in the tables.

On the Present State of Lunar Nomenclature.

By S. A. Saunder, M.A.

Some apology is due from me for again occupying the time of the Society with a subject so familiar to all selenographers as the confusion now existing in lunar nomenclature, and the inadequacy of our present system for the growing needs of selenography; but, as some recent remarks of mine* have led the Council of this Society to take a course of action which it is hoped may lead to an authoritative reconsideration of the questions involved, I have thought that a fuller statement of the difficulties might be of interest to those whose work lies in other directions, and might also lead to some useful suggestions from those who, like myself, have found themselves hampered by the want of a recognised language in which to express the results of their labours.

Our present system may be said to date from the publication of Beer and Mädler's map in 1837. In this the principal formations, such as Tycho or Copernicus, have separate names allotted to them; the smaller mountains are designated by affixing a letter to the name of some neighbouring principal formation, as Mösting A, Thebit B. But at once difficulties begin to be felt. These smaller mountains are denoted on the map only by the letters A, B . . ., and it is often far from easy to determine to which of the adjacent names this letter should be attached. Mädler was generally careful to place the letter towards that side of the object which was nearer to the named formation, but even in his map it is sometimes difficult to determine the name, and in other maps the position of the letter is no guide at all. The only safe method is to read through all that has been said in the text of *Der Mond*, or of Neison's *Moon*, under each of these headings until a description is found which applies to the mountain under consideration. This may well occupy half an hour, and sometimes three or four times as long may be spent without any result, for there are some of these lettered formations to which I have been unable to find any allusion in the text. It is frequently hard enough to identify a crater at all in a crowded region, and this further demand constitutes a considerable tax upon one's time.

As an instance of the confusion which may arise from this

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* *Memoirs R.A.S.* vol. lvii. pp. 47, 48.

1905MNRAS..66...41S

difficulty I may cite the valuable set of measures of 150 standard points published by Dr. Franz in *Breslau Mitteilungen*, vol. i.; No. 65 in that list is called Hippalus A, and no other means are given for identifying it except its position and diameter. Now I have measured the same point—it is No. 124 in my catalogue (*Memoirs R.A.S.* vol. lvii. part i.)—and, as my position differs from Dr. Franz's by less than a second of arc, whilst the diameter of the ring is about 9 seconds, there can be no doubt as to our having measured the same point. I am therefore able to identify the point on a photograph, and thence on the map. But, on referring to the text, I conclude that Mädler wrote of this as Agatharchides A, and not Hippalus A. Mädler's Hippalus A is No. 73 on my list, at a distance of nearly a minute of arc and on the other side of Hippalus. Anyone using Dr. Franz's measures as he intended them to be used, either for making a map or for determining the positions of other points, would probably have applied the measure to a wrong point, and, as it would not be absurdly wrong, he might have done a good deal of work before he found even that there was an error, and then a good deal more might be necessary before the true source was located.

A difficulty of the same character sometimes arises from the inaccuracy of the maps. When a point has been observed on the Moon, or on a photograph, it is often extremely difficult to identify it on the maps. Franz mentions this difficulty with regard to several points on his list, and, amongst others, with regard to No. 115, which he calls Pons *c*. Here, again, I have measured the same point (it is No. 1131 in my catalogue), and have come to the conclusion that it is Mädler's Pons *b*. The same confusion as before is not improbable, and these are not the only cases in which it might arise.

I should be very sorry if my selection of these instances from Dr. Franz's catalogue gave rise to an impression that I was actuated by any spirit of fault-finding. Dr. Franz has done so much towards the foundation of an accurate selenography that it would be impossible to speak of his work otherwise than with the highest admiration and respect; but, this being the case, the fact that I find myself obliged deliberately to differ from him in what ought to be so simple a matter as the right names to be applied to several amongst 150 of the most conspicuous measurable points on the Moon will be more convincing than many pages of argument that there is a real necessity for rendering the recognised names more easily discoverable.

But the difficulties do not stop here. Since Mädler's time many selenographers have considered it desirable to add new names to the list. In Mädler's map there were, according to Neison, 427 principal names: 145 of these were new, the rest being taken from the works of older selenographers. In Neison's map, which was published in 1876, there were 513 names. Of the additions one each was due to Webb, Lecoutourier, and

1905MNRAS..66...41S

Schmidt, four to Lee, fifty-eight to Birt, and fourteen to Neison, whilst two names which Mädler had been unable to identify were reinstated from Riccioli and five from Schröter. Neison says that sixty-seven of these were taken from the British Association Catalogue, but I have not been able to ascertain that this catalogue was ever published. In 1864 a Committee of the British Association was appointed for the purpose of mapping the surface of the Moon, and this Committee issued five reports in the years 1865–69; but the only thing they did for nomenclature was to suggest a series of symbols which have never been adopted, and which I certainly should not wish to see put forward again.

The subject did occupy the attention of the Selenographical Society, who suggested the partition of the Moon into regions round each of the named formations, and who issued special catalogues of a few of these regions. Such of these, however, as I have examined seem to be based entirely on Neison's map, and they will not stand a detailed comparison with the photographs.

Schmidt's map—by far the best we possess—was published in 1878, and his description of it contains about sixty new names.

Franz has recently * given new names and letters to fifty-three points, and others have made further additions from time to time.

There is no map or catalogue in existence giving a complete list of the names which have been used by even half a dozen of our greatest selenographers; whilst Elger, in his book on *The Moon*, published in 1895, almost entirely neglects the names added by Schmidt, although his map claims to be founded on Schmidt's and to show clearly every named formation.

Schmidt, whose knowledge of the lunar surface has probably never been equalled, mentions several names as in use by English selenographers, but representing formations he has been unable to identify. Some of these may be found in Neison or Elger, but others cannot, and it would require some searching to discover who the authors were and to what formations the names were applied.

It will be seen that the present nomenclature has grown, and is still growing, without any recognised control, whilst the names given by one of the greatest of selenographers have, in this country certainly, and I believe elsewhere, received no recognition.

It has resulted from this that in many instances different formations have received the same names. Each of the following has been allotted to two: Peters, Carrington, Beer, Argelander, Janssen, Leverrier, Faraday. There are also two Lockyers, though these are so close to one another that the confusion would seem to have arisen from an error in identification. Again, the names of Argelander and Janssen have been given by Schmidt and Birt respectively to the same formation, as also those of Leverrier and Miller to another, and those of Hencke and Daniell to a third.

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* *Breslau Mitteil.* vol. ii. 1903.

It is possible that careful search would reveal other instances of duplication. I mention these as having been noted in the course of my work.

The introduction of a new name has, in general, involved a change for those minor formations which are nearer to the newly named crater than to that by whose name they were previously known. These retain the old letters but take the new name. Thus, when the name Murchison was given by Birt, the adjacent crater Triesnecker A became Murchison A. This same crater, Murchison A, has been named Chladni by Schmidt, and is erroneously called Murchison by Franz.

When the name Flammarion was introduced Mösting A should, in accordance with precedent, have become Flammarion A. But, thanks to the researches of Dr. Franz, Mösting A is to the Moon what Greenwich is to the Earth, the one point from which others are measured, and such a change would be intolerable; but we are left with the anomaly that Mösting A, which is nearly fifty miles from Mösting, is actually on the wall of Flammarion.

Both capital and small letters are used to denote the minor formations; thus Ptolemæus A and Ptolemæus *a* are quite distinct, whilst in some cases a third form, a, is introduced. This is an obvious disadvantage, as great care is necessary to prevent errors in transcription. Mädler's rule was to use capital letters for measured formations, small letters for those which were unmeasured; Roman letters for depressions, Greek for elevations. But he did not adhere rigidly to these rules himself, and others have entirely neglected them. The rule with regard to capital and small letters is now quite unworkable, for it would involve a change of name when a previously unmeasured formation is measured, and moreover it would frequently be found that the corresponding capital had been already appropriated. The similarity of the capitals A and B in the two alphabets is another cause of confusion, though here again Mädler usually indicates a difference. Finally different letters are sometimes applied to the same crater in different maps, or the same letter to different craters.

Enough has been said to give an idea of the difficulties under which selenography labours, and further, as individual formations are studied and mapped, the number of small craters to be named may be increased twenty- or thirty-fold. It is eminently desirable that their designations should be allotted upon some uniform system.

If a remedy is to be found which will meet with universal assent—and nothing short of this would be a remedy at all—it is obvious that it must be the work of an international committee.

1905MNRAS..66...41S

Hence the Council of the Royal Astronomical Society has passed a resolution that the International Association of Academies should be asked to nominate a committee to report upon the present state of Lunar Nomenclature, and to suggest a course of action for the future.

Part of the work of such a committee would be tedious, but would present no other difficulty. A list of all the cases of ambiguous nomenclature might be drawn up, and a decision taken as to which names should remain. It ought, also, not to be very difficult to devise rules for future guidance, and, if it were thought advisable to leave opportunities for the introduction of new names, to provide some simple machinery for the official sanction and publication of such introduction.

But the real difficulty would be to devise a means by which the decisions of the committee may be made intelligible to the world in general; to devise means by which selenographers may be enabled to identify with comparative ease the formation corresponding to any given name, or the name allotted to any given formation.

The ideal plan would be to prepare an accurate map, but this would seem to be a counsel of perfection. Schmidt spent thirty-four years in the preparation of his map, and we want a better. It is true that the photographs would to a certain extent diminish the labour; but even with these it would involve many years of patient work, whilst the knowledge, skill, and opportunity required to bring it to a successful issue are such as could rarely be found united in any one person.

It remains, then, to consider whether the photographs cannot be used directly, and I venture to put forward the following suggestions for criticism, in the hope that they may indicate a direction along which a solution may be ultimately found :—

If a series of four or five of the best modern photographs, showing the Moon under different illuminations, were enlarged to a diameter of from 12 to 18 inches, and the enlargements developed with impressed réseaux, so that the lines should appear in the same positions in all copies, it might be possible to identify a sufficient number of formations upon these and to give their positions in terms of réseaux coordinates. Two catalogues might then be formed, one so arranged that the name corresponding to any given formation could be at once ascertained, and the other so that the formation bearing a given name could be found. It is well known that photographs do not show anything like the amount of detail that can be seen with even a moderate telescope, but they do show a great deal. Mr. Hardcastle has partly measured more than 1800 small craters on one of Mr. Ritchey's exquisite negatives, and this by no means exhausts the number that could be identified on this one plate alone. The only part in which I should anticipate serious difficulty would be in the regions near the east and west limbs, of which it is not easy to get photographs showing much detail. Possibly these might require special treatment.

Formulæ might be given for each plate for converting the réseaux coordinates into absolute selenographical coordinates, but the former would be more convenient for identification and for reference.

There are other questions which would also engage the attention of such a committee as has been proposed. Professor Shaler, writing as a "geologist and geographer,"[*] has expressed the opinion that the present system of nomenclature is crude and inadequate; that the analogies suggested are often misleading; and that many of the more important features, such as capes, have been left unnamed. He suggests the appointment of just such a committee as is now advocated to undertake possibly the revision, and certainly the extension, of the present system.

Professor W. H. Pickering, again, has urged[†] that the existing names have been unfortunately allotted; that in many cases large and important areas have received the names of men who have done little for selenography, or even for astronomy, whilst many men who should be really commemorated are represented by small and insignificant craters. It is probably too late to alter this, but the criticism might well be considered by the committee.

On a New Method of Determining the Moon's Position photographically. By E. B. H. Wade, M.A.

(*Communicated by Professor H. H. Turner.*)

(1) Several methods have been proposed for determining photographically the Moon's position, either with a view to finding ephemeris errors or, given these, the longitude of a place. Amongst these methods we may mention that of Major Hills, R.E.,[‡] in which a rigidly mounted camera is used to photograph the trails of suitable stars preceding the Moon, after which instantaneous exposures are made on the Moon itself, and finally further exposures are made for star-trails following the Moon. Again Professor Turner[§] has indicated a method of obtaining photographic transits which would be quite applicable to Moon culminations. Finally the same author has described[||] an extremely direct method in which the Moon is photographed amongst the stars immediately surrounding it. Over-exposure of the Moon's image relatively to the stars is avoided by

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[*] "A Comparison of the Features of the Earth and the Moon," *Smithsonian Contributions to Knowledge*, No. 1438, pp. 75, 76.

[†] *Harvard Annals*, vol. li. pp. 14, 15.

[‡] *Mem. R.A.S.* vol. liii.

[§] *Monthly Notices*, lvii. p. 349.

[||] *Monthly Notices*, lxiv. p. 19.